

2010

Learners' Perceived Effectiveness of Wikis for Team Projects

Elizabeth Koh

National University of Singapore, diskre@nus.edu.sg

John Lim

National University of Singapore, jlim@nus.edu.sg

Follow this and additional works at: <http://aisel.aisnet.org/pacis2010>

Recommended Citation

Koh, Elizabeth and Lim, John, "Learners' Perceived Effectiveness of Wikis for Team Projects" (2010). *PACIS 2010 Proceedings*. 51.
<http://aisel.aisnet.org/pacis2010/51>

This material is brought to you by the Pacific Asia Conference on Information Systems (PACIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in PACIS 2010 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

LEARNERS' PERCEIVED EFFECTIVENESS OF WIKIS FOR TEAM PROJECTS

Elizabeth Koh, Department of Information Systems, School of Computing, National University of Singapore, diskre@nus.edu.sg

John Lim, Department of Information Systems, School of Computing, National University of Singapore, jlim@nus.edu.sg

Abstract

From a humble information system wikis have evolved in both business organizations and educational institutions, catering to, among other uses, training and education. The current work focuses on wiki-based learning and aims to address a visible gap in research. Much previous work is but prescriptive guidelines and self-reflections. While attempts exist involving some assessments of wiki-related teams, they use short-term teams and place their concern on only outcomes. We advocate examination of mature teams as well as the interaction process. The current study pays attention to two aspects earlier suggested salient: learners' prior wiki experience and instructor's support. It offers in-depth understanding of wiki effectiveness in collaborative learning environments, operationalized using project teams. A theoretical model is developed, proposing wikis to positively affect learning outcomes of self-reported learning, process satisfaction, positive social environment and a sense of community, through the processes of task-related and socio-emotional activities. The model posits wiki experience and instructor support to enhance these activities. Tested using two separate wikis (Mediawiki and Confluence) over a protracted period of one semester, our findings show strong support for wiki effectiveness, contributing to research areas such as wikis and small groups. Implications for wiki development and instructional use are derived.

Keywords: Wiki, Team, Effectiveness, Small group behaviour, Learning, Education

1 INTRODUCTION

From a humble information system in which multiple people could edit a workspace, wikis have evolved and found myriad of uses in organizations (Leuf & Cunningham 2001; McAfee 2006). This is especially true in education, where wikis have been deployed as a means to promote deeper learning, enhance collaboration skills and facilitate the knowledge discovery of students (Parker & Chao 2007; Chen et al. 2005). Wikis, basically websites where many authors can edit, are primarily being used in research and writing assignments, group authoring projects, peer review and online/distance education (Hew & Cheung 2009; Kane & Fichman 2009). More studies have been published regarding wiki use in education. However, these studies have mainly been descriptive with prescriptive guidelines or a self-reflection without rigorous investigation (Hew & Cheung 2009). Some papers provide theoretical explanations and report technical designs of the wiki. Still, empirical efforts examining learning outcomes from using the wiki is needed (Forte & Bruckman 2007). Moreover, many studies were short-term which prevented mature groups from using wikis and could have led to a novelty effect (Hew & Cheung 2009). Research has suggested that students' previous experience with wikis could affect the team interaction and learning outcomes (Shih et al. 2006; Hong 2002). Similarly, in online learning, studies have questioned the role of the instructor, who may not be as visible in the wiki (Lund & Smødal 2006; De Laat et al. 2007). More in-depth research and measurement of wiki effectiveness in collaborative learning environments is needed (Wagner 2004).

While wikis can be used for large classes, this research focuses on wikis used with teams. In this way, the paper adds to the line of research from small group and socio-psychology research. In addition, the paper will open up the black-box of input-outcome studies by examining the interaction processes that occur in small group activities. Pioneer research by Bales (1950) showed that a group is in a continual state of dividing its time and work between instrumental (task-related) and expressive (socio-emotional) needs. Thus, interacting processes consists of two main types of behavior – task-related and socio-emotional activities. In this regard, learning outcomes examined should relate to both the learning performance and socio-related outcomes of students (Kreijns et al. 2002).

The paper asks, does the use of a wiki for team projects improve learning outcomes? Specifically the paper examines the role of wiki experience and instructor support on task-related and socio-emotional activities and its impact on self-reported learning, process satisfaction, positive social environment and a sense of community. This paper also contributes toward understanding the impact of different types of wiki software in education as data was collected from two wikis, one based on Mediawiki software and the other, Confluence software. Theoretical and practical implications from this research will be discussed.

The structure of the paper is as follows. First, the conceptual framework of the research is laid out. The paper will elaborate on the importance of wikis in team projects, the interaction process and learning outcomes. Research hypothesis will also be proposed followed by the description of the research model. Next, the research methodology will be delineated and the data analyzed. The paper ends with a discussion and conclusion section.

2 CONCEPTUAL FRAMEWORK

2.1 Wikis for Team Projects in Education

Wikis are starting to become common in educational landscapes due to the technology being easily available through various free hosted solutions and open-sourced solutions. Elgort (2007) describes wikis used in education as “academic or learning wikis, incorporating elements of social software, a group project tool and an academic study tool” (p.236). See Parker and Chao (2007) for more details about wikis.

Wikis have been used in many ways such as the construction of a case library, wiki Micropedias, FAQ wikis, crowdsourced textbooks, problem solving wikis, and project spaces ((Kane & Fichman 2009). For instance, one of the forerunners of wiki systems for education is the CoWeb implemented

at the Georgia Institute of Technology (Guzdial et al. 2001). The CoWeb usage can be divided into these three areas: distribution of information, creation of collaborative artifacts, and discussion and review. Another example is the use of wikis as textbooks. Ravid and colleagues used a wiki to develop a Hebrew textbook on Information Systems (Ravid et al. 2008). This wiki was seeded with an older version of a textbook and students were responsible for updating content to it.

Although there are a myriad of uses, wikis are heralded for its ability to allow group authorship in which team members use a shared workspace to discuss and create a co-written document in the context of learning (Parker & Chao 2007). Socio-constructivism suggests that people learn best when they share, cooperate, reflect and negotiate (Vygotsky 1978). Also known as collaborative learning, the theory has been a guiding principle in many educational activities such as team projects.

2.2 The Interaction Process and Learning Outcomes

While many studies have examined the relationship between wiki use and learning outcomes, an understanding of the process via opening up the black box is in want. Fundamentally, any small group occupies itself with two types of activities – task-related and socio-emotional activities. This perspective is derived from Bales' (1950) seminal research, which identifies that groups continually divide their time between instrumental (task-related) and expressive (socio-emotional) needs. The research theorized an equilibrium model in which groups seek to maintain a balance of instrumental and expressive acts through progressive stages. Successful group outcomes then depend on how groups are able to solve the task and maintain member satisfaction. Some studies have expanded the two processes into three processes dividing socio-emotional activities into relating to others and representing the group e.g. the Cognitive three-process model of group interaction (Whitworth et al. 2000). Similarly the "Time, Interaction, and Performance" model (McGrath 1991) regards group behavior as consisting of production, well-being, and member-support processes. While differing ways of dissection have been attempted, none deviates from the fundamental task-social perspective.

Moreover, in traditional IS and education research, the social aspect of interaction has been frequently overlooked. The focus is only on task-related activities. For instance, (Bonk et al. 1998) referred to socio-related activity as "social acknowledgments" in students' postings. Moreover, they regarded these interactions as unproductive. A whole stream of CMC research has also just focused on task-oriented communications while ignoring the socio-oriented activities (Liu 2002). This paper regards task-related and socio-emotional activities as important for learning outcomes. Viewing one type of interaction alone is insufficient to fully investigate the impact of wiki use over time.

The outcomes of interactions in online collaborative learning can be conceptualized to affect the learning performance and socio-related outcomes of students (Kreijns et al. 2002). Learning performance consists of the domains cognition and affect, and include academic achievement, self-reported learning, and process satisfaction (Bloom 1956; Hew & Cheung 2009). On the other hand, socio-related outcomes deal with feeling, being and relationships. It is a measure of the student's ability to interact with other people and to function in groups. More specifically, socio-related outcomes emphasize the social environment as a result of interactions on the system. It includes the measures of a positive social environment and a sense of community (Kreijns et al. 2007; Rovai 2002; Arbaugh & Benbunan-Fich 2006).

2.2.1 Task-related activity

Task-related activity could affect the learning performance and socio-related outcomes of students. Higher task-related activity would imply that students are thinking and analyzing the problem and putting effort into solving it. When students verbalize and write out their thoughts, students are able to reflect about the task at hand and also generate new ideas. Textual communication between students also allows students to clarify their thoughts, develop their frame of thinking, share their thoughts and feelings and build relationships with others. Several studies have reported that students perceived that the wiki facilitated learning of course concepts (Forte & Bruckman 2007; Minocha & Thomas 2007). Mindel and Verma (2006) found that the wiki enables collective knowledge in a course and a

chronological history of the evolution of the knowledge base. Students perceived the value in using wikis such as encouraging dialogue while writing, which improves the quality of their output.

Moreover, increasing task-related activity could also enhance satisfaction. Ras and colleagues (2007) found that students had positive attitudes toward the wiki as they used it. Students feed backed that the system saved them effort in experience management, requirements, design, quality assurance and project management in the Computer Science course. However, the study lacked direct measures to assess reflective learning and the evaluation was rather heuristic. Still, the empirical study contained objective (wiki statistics) and subjective measures (through a questionnaire). In addition using wikis for team projects could enhance the social environment and the sense of community (Fuchs-Kittowski & Köhler 2005). This provides support for the following hypotheses:

H1: Higher task-related activities will be associated with a) higher academic achievement, b) higher self-reported learning, c) higher process satisfaction, d) more positive social environment and e) increased sense of community.

2.2.2 *Socio-emotional activity*

Socio-emotional activity has been highlighted as important for the development of higher learning outcomes (Barab & Duffy 2000). One key assumption is that socio-emotional activity is predominantly positive in nature rather than negative. The feelings of comradeship, solidarity, care and concern for each other will enable students to work together cohesively in a group, thereby producing better results (Kreijns et al. 2007). Students will also perceive that they have learnt more (Arbaugh & Benbunan-Fich 2006). Socio-emotional activity will lead to groups being more satisfied with their process of interaction and also the result. Socio-emotional behavior among members such as self-disclosure, introductions, courtesy, exchanging views and valuing them in a group, will engender feelings of community, trust, sense of belonging etc. This will enhance the socio-related outcomes of the group. The resulting hypotheses are:

H2: Higher socio-emotional activities will be associated with a) higher academic achievement, b) higher self-reported learning, c) higher process satisfaction, d) more positive social environment and e) increased sense of community.

2.3 **Wiki Experience**

Previous wiki experience could affect subsequent interaction processes and outcomes. Past literature has suggested that previous computer experience is a differentiating factor with students who use ICT tools to learn (Yan 2006; Shih et al. 2006). Students who had more computer experience were more satisfied with their web-based course (Hong 2002). Other research shows that previous computer experience does affect subsequent computer performance (Yan 2006). A longitudinal study by Yan (2006) examined four types of previous experiences – computer network experience, statistical program experience, email experience, years of computer use. The study found that students' who had previous experience with using computer network systems performed better initially in the project. The author explains that this due to the transfer of specific skills which were relevant to completing the project. In the same way, previous experience with a wiki, which includes students' knowledge of how to navigate the wiki, how to edit text and discuss etc., would be instrumental in enabling task and socio-emotional activity in the wiki. The following hypotheses are proffered:

H3a: Previous experience of using wikis will predict task-related activity such that more experience will result in higher task-related activity.

H3b: Previous experience of using wikis will predict socio-emotional activity such that more experience will result in more positive socio-emotional activity.

2.4 The Role of the Instructor

The responsibility of the instructor is increasingly being studied in online contexts (De Laat et al. 2007; Lund & Smødal 2006). This is more so in the context of a wiki where typically the instructor and the student seem to have equal use of the wiki. Lund and Smordal (2006) investigated the instructor's presence in a wiki. They find that wikis do not provide an online space for the instructor as the instructor has the same amount of user rights as the student such as create, edit, move and rename pages and upload files. They are not administrators who can protect pages, delete pages and ban users. This is unlike learning management systems which grants the teacher more access rights and the ability to create and delete pages. Moreover, the instructor's space on the wiki is virtually the same as the student's space. This makes the role of the instructor more ambiguous.

Nevertheless, there is evidence for the importance of instructor support. Instructor support is beneficial in order to scaffold the learning ability of students so that learner can solve problems or accomplish tasks that would otherwise be out of reach. Garrison and colleagues (2000) add although social and task-related interactions are necessary in online environments, they are not sufficient to ensure higher learning outcomes; rather, instructor support is required "to design and integrate the cognitive and social elements of a community of inquiry for educational purposes" (p. 92). Research has also demonstrated the importance of indirect instructor support which could be in the form of instructional design and structure developed by educators and educational technologists (Kanuka et al. 2007; Elgort 2008; Mindel & Verma 2006).

Cubric (2007) reports that students were unwilling to engage in wiki learning activities possibly because of unfamiliarity with collaborative learning and low interest. Instructors had to stimulate the student's interaction with the wiki. The research concludes that the student's interaction with the wiki and other learners depended on the frequency and quality of the instructor interactions, and also the weight of the assignment (Cubric 2007). Thus, the paper believes that instructor support is positively related to task-related and socio-emotional activity.

H4a: Instructor support will predict task-related activity such that more instructor support will result in higher task-related activity.

H4b: Instructor support will predict socio-emotional activity such that more instructor support will result in more positive socio-emotional activity.

2.5 Research Model

Informed by the literature discussed earlier, a theoretical model comprising wiki experience, instructor presence, the instrumental processes of task-related and socio-emotional activity and finally learning outcomes, self-reported learning, process satisfaction, positive social environment and a sense of community is developed (Figure 1). All the relationships are in the positive direction.

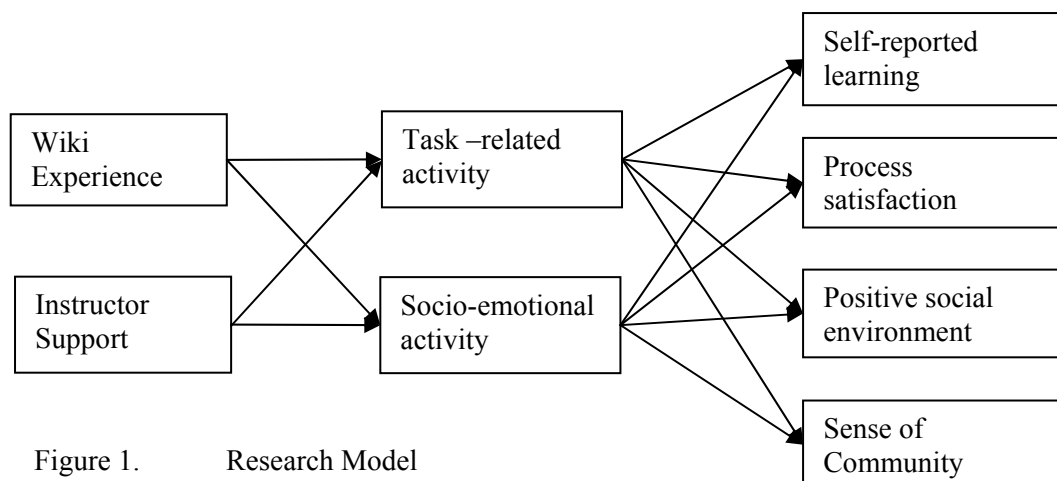


Figure 1. Research Model

3 RESEARCH METHODOLOGY

The survey methodology was chosen to investigate students' perceptions of wiki effectiveness. The survey method is useful for examining relationships between attitudes and beliefs. Survey items were sourced from past literature. A pre-test was conducted with 5 faculty members for content validity. The sorting resulted in the deletion of ambiguous items. The questionnaire is shown in Table 1.

A wiki was utilized in a module that taught societal issues related to information and communication technology (ICT) for a team project. This project required students to write a report on a particular aspect of ICT. It counted towards 50% of students' course grades. The pedagogical goal of this project was for students to gain in-depth knowledge of ICT issues. It was hoped that the students would be able to learn to use wiki systems to collaborate more easily and create their report. This project was carried out twice over two semesters under the same instructors. In the first semester, the wiki software, Mediawiki was utilized. In the second semester, the wiki software, Confluence was used. The reason for the change of wiki software is that the University recently acquired the Confluence software and made it available for all students and the instructors wanted to try out this new system.

There are slight differences in the features of the wiki software. Mediawiki is the software used by Wikipedia, a popular online encyclopedia and its interface is familiar to most students. It is available freely and open source. Mediawiki does not have WYSIWYG editing¹ and students can find learning wiki mark-up language difficult to use. Moreover, comments are written in a free-flow discussion page. On the other hand, Confluence is a hosted wiki solution by Atlassian. Confluence has WYSIWYG editing, and its comments are in a threaded form, making it easier to follow discussions. Students can indicate if they want changes to the wiki to be emailed to them, and they could also upload a user profile photo. Screenshots of the two software are shown in Figures 2 and 3.

For both wikis, students used it for about 4 months for their team project. The survey was conducted when their project was completed. Survey participation was voluntarily and additional participation marks were awarded to students if they participated. This resulted in 45 respondents for the first wiki and 86 respondents for the second one. Data was analyzed at the individual level. The average age of students was 21.71 and 20.43 for the first and second wiki respectively. There were 77.8% males (22.2% females) in the first survey and 54.7% (45.3% females) in the second. In both surveys, there were more males which is typical in a computing course. Other demographics are reported in Table 2 while the mean results for the items are also shown in Table 1.

4 DATA ANALYSIS AND RESULTS

Partial least squares (PLS) analysis was utilized to test the significant relations among the variables. PLS does not have distributional assumptions of data normality and is able to handle small-to medium-sized samples (Chin 1998).

4.1 Wiki 1: Mediawiki

Tests to the measurement model revealed adequate reliability and convergent validity. One area of concern was the high correlation between TRA, SEA, SRL and PSA as seen in Table 3. PLS tends to generate higher correlations than other methods and past research has used these data for further tests (Fuller et al. 2006). Moreover, cross loadings of each latent variable correlation were an order of magnitude larger for its theoretically assigned measurement item compared to the other items which is a criteria for discriminant validity to be met (Gefen & Straub 2005).

¹ WYSIWYG editing refers to software where "what you see is what you get" i.e. users' typed messages are equivalent to what they see on the screen. Software that does not have WYSIWYG editing requires the entering of mark-up language which is different from what will finally be displayed.

Constructs	Measures	Mean (Wiki 1)	Mean (Wiki 2)	Sources
Instructor Support (ISP)				
ISP1	I was aware of the instructor's online presence	3.51	3.88	(Garrison et al. 2000; Kanuka et al. 2007)
ISP2	The instructor was available to me	3.93	4.23	
ISP3	The instructor was available to my group members	4.02	4.36	
ISP4	The instructor facilitated my group's activity in the online medium	3.58	3.76	
ISP5	Overall, I had a great deal of interaction with my instructor	3.42	3.63	
Task-related Activity (TRA)				
TRA1	I made suggestions about the task	5.20	5.73	(Bales 1950; Green & Taber 1980)
TRA2	I gave information about the problem	5.38	5.56	
TRA3	I asked for information from others	4.98	5.38	
Socio-emotional Activity (SEA)				
SEA1	Others expressed a positive opinion about your behavior	5.13	5.12	(Bales 1950; Green & Taber 1980)
SEA2	I was unfriendly (reversed)	5.69	5.95	
SEA3	I was frustrated (reversed)	5.93	6.07	
Self-reported learning (SRL)				
SRL1	I was more confident in expressing ideas	4.87	5.12	(Alavi 1994)
SRL2	I learned to interrelate important topics and ideas	5.09	5.20	
SRL3	I increased in understanding of basic concepts	4.91	5.27	
SRL4	I learned to identify central issues	5.04	5.14	
Process Satisfaction (PSA)				
PSA1	My team's problem-solving process was fair	5.11	5.33	(Green & Taber 1980)
PSA2	My team's problem-solving process was understandable	5.00	5.30	
PSA3	My team's problem-solving process was satisfying	5.18	5.33	
Positive Social Environment (PSE)				
PSE1	Teammates felt free to criticize ideas, statements, and/or opinions of others	5.16	5.57	(Kreijns et al. 2007)
PSE2	Teammates ensured that we kept in touch with each other	5.00	5.47	
PSE3	We worked hard on the team assignment	5.13	5.76	
PSE4	I maintained contact with all other teammates	4.98	5.58	
PSE5	Teammates gave personal information on themselves	4.53	5.22	
PSE6	The team conducted open and lively conversations and/or discussions	4.89	5.45	
PSE7	Teammates took the initiative to get in touch with others	4.91	5.40	
PSE8	Teammates spontaneously started conversations with others	4.73	5.42	
PSE9	Teammates asked others how the work was going	4.80	5.48	
Sense of Community (SCO)				
SCO1	I feel that students in this course care about each other	3.93	4.65	(Rovai 2002)
SCO2	I feel connected to others in this course	4.09	4.63	
SCO3	I feel that this course is like a family	3.60	4.17	

Table 1. List of Constructs and Measures

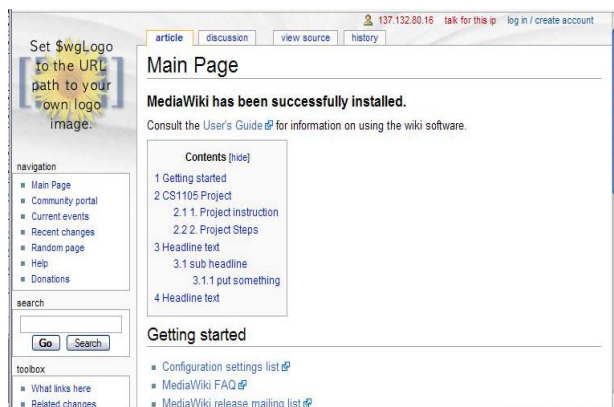


Figure 2. Screenshot of Mediawiki



Figure 3. Screenshot of Confluence

Variable	Category	Survey 1 (Mediawiki)		Survey 2 (Confluence)	
		Number	Percentage	Number	Percentage
Computer Experience	Less than 2 years	0	0	0	0
	2-4 years	2	4.4	0	0
	4-6 years	3	6.7	12	14.0
	6-8 years	11	24.4	20	23.3
	More than 8 years	29	64.4	54	62.8
Wiki Experience (WEP)	Just for this course	15	33.3	48	55.8
	Less than 1 year	10	22.2	9	10.5
	1-2 years	7	15.6	11	12.8
	2-3 years	7	15.6	13	15.1
	More than 3 years	6	13.3	5	5.8

Table 2. Demographics of Respondents from both Surveys

	CR	α	AVE	WEP	ISP	TRA	SEA	SRL	PSA	PSE	SCO
WEP	1.000	1.000	1.000	1.000							
ISP	0.944	0.925	0.771	<i>0.091</i>	0.878						
TRA	0.944	0.911	0.849	<i>-0.186</i>	<i>0.284</i>	0.921					
SEA	0.927	0.882	0.809	<i>-0.116</i>	<i>0.169</i>	<i>0.772</i>	0.900				
SRL	0.974	0.965	0.904	<i>-0.107</i>	<i>0.019</i>	<i>0.606</i>	<i>0.711</i>	0.951			
PSA	0.937	0.899	0.832	<i>-0.334</i>	<i>0.208</i>	<i>0.739</i>	<i>0.721</i>	<i>0.603</i>	0.912		
PSE	0.981	0.978	0.853	<i>-0.029</i>	<i>0.304</i>	<i>0.584</i>	<i>0.649</i>	<i>0.515</i>	<i>0.588</i>	0.924	
SCO	0.949	0.921	0.861	<i>0.052</i>	<i>0.089</i>	<i>0.257</i>	<i>0.453</i>	<i>0.488</i>	<i>0.313</i>	<i>0.676</i>	0.928

Note: CR= Composite Reliability, α = Cronbach's Alpha, AVE= average variance extracted, Italics = Correlations between constructs, Bold = square root of AVE

Table 3. Measurement Model Results from Wiki 1 – Mediawiki

Figure 4 reports the results of the statistical analysis of the structural model with bootstrapping. TRA could explain 13% of the variance while SEA could only explain 5% of the variance from wiki experience and instructor support. Nevertheless there were relatively large R-squared values for SRL (51%), PSA (60%), PSE (44%) and SCO (23%) indicating that the model has good explanatory power. Seven out of the 12 hypotheses were supported.

4.2 Wiki 2: Confluence

Tests to the measurement model revealed general acceptable reliability, convergent validity and discriminant validity (Table 4). The structural model results are shown in Figure 5. TRA could explain 2% of the variance while SEA could explain 8% of the variance from wiki experience and instructor support. The R-squared values for SRL was 27%, PSA 16%, PSE 25% and SCO 9%. Six of the 12 hypotheses were supported. In addition, H4b was mildly significant, $p=.059$, in the proposed direction.

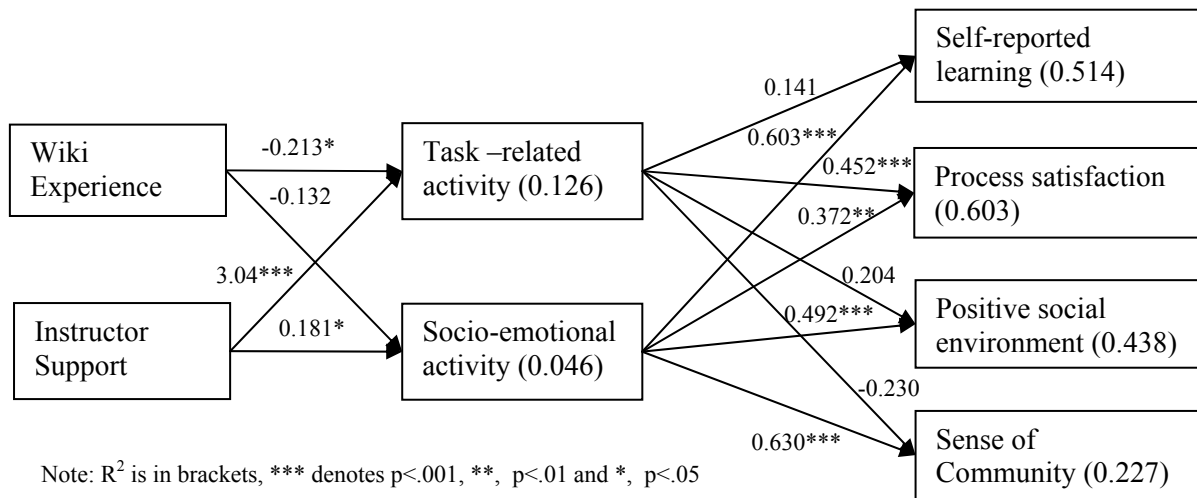


Figure 4. Results from Wiki 1 – Mediawiki

	CR	α	AVE	WEP	ISP	TRA	SEA	SRL	PSA	PSE	SCO
WEP	1.000	1.000	1.000	1.000							
ISP	0.932	0.908	0.734	0.142	0.857						
TRA	0.882	0.805	0.713	0.127	-0.031	0.844					
SEA	0.751	0.686	0.509	0.060	0.282	0.476	0.713				
SRL	0.946	0.925	0.816	-0.111	0.227	0.463	0.420	0.903			
PSA	0.955	0.929	0.876	0.077	0.047	0.295	0.383	0.215	0.936		
PSE	0.948	0.938	0.673	0.060	0.099	0.400	0.455	0.516	0.481	0.820	
SCO	0.949	0.919	0.861	-0.007	0.076	0.182	0.291	0.424	0.356	0.528	0.928

Note: CR= Composite Reliability, α = Cronbach's Alpha, AVE= average variance extracted, Italics = Correlations between constructs, Bold = square root of AVE

Table 4. Measurement Model Results from Wiki 2 – Confluence

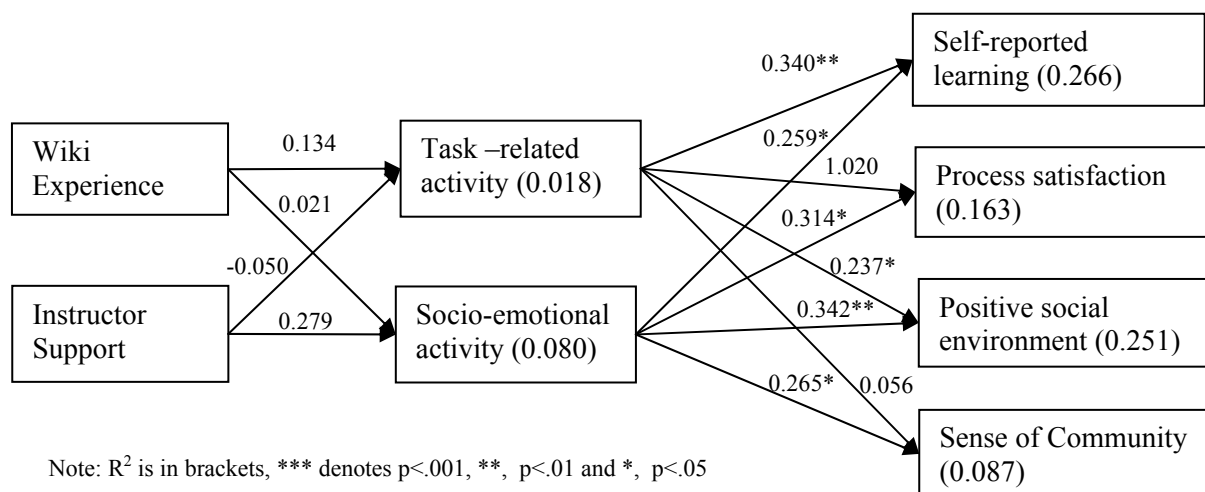


Figure 5. Results from Wiki 2 – Confluence

5 DISCUSSION AND CONCLUSION

This paper examines the effectiveness of wikis for student team projects. The research has delineated the importance of examining both instrumental and expressive needs of teams. The data shows strong support for the relationship between positive socio-emotional activity and self-reported learning, process satisfaction, positive social environment and sense of community (Hypothesis 2). The relationship is robust enough to be observed in two separate wikis which possessed different features. It could be argued that Confluence had richer features than Mediawiki such as threaded discussions, email notification and profile photos. Yet the data revealed similar learning outcomes from positive socio-emotional activity in both wikis. A possible reason is due to students' adaptive use of technological structures (DeSanctis & Poole 1994) where they adapted the system to cater to their expressive needs. Looking broader, this could also explain why simplistic tools like Twitter are gaining popularity due to people adapting the tool to provide for social interaction.

Hypothesis 1 was not supported evenly across the two wikis. A possible reason is that information shared was redundant or unrelated to the learning task. For instance, a team member may contribute a lot of useful information but if the information is not well-received by other members and not used in the task, this would lead to decreased satisfaction, social environment and sense of community. Another reason is information overload which results in learners being unable to synthesize their thoughts, hence hindering learning.

From the data, wiki experience did not affect task-related or socio-emotional activity. A possible reason is the length of time the wiki was used and the time at which the survey was taken. In both wikis, students used the wiki for almost 4 months and the survey was administered after that. Studies have shown that previous computer experience affects only the initial transfer of information (Yan 2006). Wiki experience could have given students a head start in their initial team activity but by the later stages, this initial advantage could conceivably have outlived its usefulness.

As for the role of the instructor, this was supported more strongly in Mediawiki than Confluence. This could be due to the second wiki being hosted University-wide. Students did not feel the instructor's presence as closely as in the first wiki, which was set-up specifically for the course. Nevertheless, the relationship between instructor support and socio-emotional activity was mildly significant in the second wiki, suggesting that in both wikis the instructor's guidance, instructional support and interaction with students was helpful to students' interaction process and outcomes.

This study suffers from several limitations. The research did not statistically compare the two wiki software to determine the effectiveness of a particular type of wiki. This was because it was not the focus of the research. Moreover, the researchers were unable to guarantee that all the features of the wiki were utilized. For instance students might not have uploaded a photo or used the discussion pages in the wiki. Second, the paper had small sample sizes and not all students who used the wiki participated in the survey. Third, results from this study may not be able to generalize to other contexts due to the uniqueness of the team, task etc. Going further, the authors will examine specific features of the wiki which could apply to a broader context. In addition, academic performance and other contextual factors such as quality of past wiki experience could be investigated.

Despite the limitations, the research has contributed in several ways. Theoretically, it has shown the importance of viewing both the task and social aspects of team activity. The social aspect has traditionally been ignored in the past. Moreover, socio-emotional activity illuminates the black-box of input-output models. The data solidly supports that positive socio-emotional activity enhances learning outcomes. Third, this study also adds to the empirical research of wiki effectiveness backed with research rigor.

Practically, this paper demonstrates that the choice of wiki software does not seem to influence learning outcomes too much. Rather, issues like cost, availability etc. may determine the actual wiki service chosen. Second, wiki services and instruction need to cater specifically to the social-emotional activity of teams. As these activities affect outcomes, designers and instructors should develop

functions that will maintain the positive activity of the team such as a positivity level indicator. Third, the paper also suggests that instructors still play an important part in facilitating student outcomes in wiki-based project teams.

Wikis are being rampantly used in many industries. This is no different in education. This paper provides a theoretical lens for the effectiveness of wikis for student team projects. Specifically, the paper has conceptualized that wikis positively affect learning outcomes of self-reported learning, process satisfaction, positive social environment and a sense of community through the processes of task-related and socio-emotional activity. Wiki experience and instructor support were also proposed to enhance these activities. Tested using two separate wikis (Mediawiki and Confluence) over a protracted period of one semester, findings show consistent and strong support for wiki effectiveness. Indeed, this line of research coupled with popular support for the wiki points to a bright future for wiki use and evolution.

References

- Alavi, M. (1994). Computer-mediated collaborative learning: An empirical evaluation. *MIS Quarterly*, 18(2), 59-174.
- Arbaugh, J., and Benbunan-Fich, R. (2006). An Investigation of Epistemological and Social Dimensions of Teaching in Online Learning Environments. *Academy of Management Learning Education*, 5(4), 435-447.
- Bales, R. (1950). A Set of Categories for the Analysis of Small Group Interaction. *Am Sociol Rev*, 15(2), 257-263.
- Barab, S. and Duffy, T. (2000). From practice fields to communities of practice. In D. Jonassen & S. Land (Eds.), *Theoretical foundations of learning environments* pp. 25-56). Mahwah, NJ, Lawrence Erlbaum.
- Bloom, B. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. David McKay Co Inc, New York.
- Bonk, C., Malinowski, S., Angeli, C., and East, J. (1998). Web-based case conferencing for pre-service teacher education: electronic discourse from the field. *Journal of Educational Computing Research*, 19(3), 269-306.
- Chen, H., Cannon, D., Gabrio, J., Leifer, L., Toye, G. and Bailey, T. (2005). Using wikis and weblogs to support reflective learning in an introductory engineering design course.
- Chin, W. (1998). The partial least squares approach for structural equation modeling. In G. Marcoulides (Eds.), *Modern Methods for Business Research* pp. 295-336). Hillsdale, NJ, Erlbaum.
- Cubic, M. (2007). Wiki-based process framework for blended learning. In *Proceedings of the International Symposium on Wikis* (pp. 11-24). Montreal, Quebec, Canada: ACM, New York, NY.
- De Laat, M., Lally, V., Lipponen, L., and Simons, R. J. (2007). Online Teaching In Networked Learning Communities: Approach To Studying The Role Of The Teacher. *Instructional Science*, 35(2007), 257-286.
- DeSanctis, D., and Poole, M. (1994). Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory. *Organization Science*, 5(2), 121-147.
- Elgort, I. (2008). Using wikis as a learning tool in higher education. In *Proceedings of the ascilite Singapore*.
- Forte, A., & Bruckman, A. (2007). Constructing text: Wiki as a toolkit for (collaborative?) learning. In *Proceedings of the The International Symposium on Wikis* (pp. 31-42). Montreal, Quebec, Canada: ACM: York, NY.
- Fuchs-Kittowski, F., & Köhler, A. (2005). Wiki communities in the context of work processes. In *Proceedings of the WikiSym* (pp. 33-39). ACM Press.
- Fuller, M. A., Hardin, A. M., and Davison, R. M. (2006). Efficacy in Technology-Mediated Distributed Teams. *Journal of Management Information Systems*, 23(3), 209-235.
- Garrison, D. R., Anderson, T., and Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2-3), 87-105.

- Gefen, D., and Straub, D. (2005). A Practical Guide To Factorial Validity Graph: Tutorial And Annotated Example. *Communications of the Association for Information Systems*, 16(2005), 91-109.
- Green, S., and Taber, T. (1980). The effects of three social decision schemes on decision group process. *Organizational Behavior and Human Performance*, 25(1), 97-106.
- Guzdial, M., Rick, J., and Kehoe, C. (2001). Beyond Adoption to Invention: Teacher-Created Collaborative Activities in Higher Education. *The Journal of the Learning Sciences*, 10(3), 265-279.
- Hew, K., and Cheung, W. (2009). Use of wikis in K-12 and higher education: a review of the research. *International Journal of Continuing Engineering Education and LifeLong Learning*, 19(2/3), 141-165.
- Hong, K. S. (2002). Relationships between students' and instructional variables with satisfaction and learning from a Web-based course. *The Internet and Higher Education*, 5(3), 267-281.
- Kane, G. C., and Fichman, R. G. (2009). The Shoemaker's Children: Using Wikis For Information Systems Teaching, Research, And Publication. *MIS Quarterly*, 33(1), 1-17.
- Kanuka, H., Rourke, L., and Laflamme, E. (2007). The influence of instructional methods on the quality of online discussion. *British Journal of Educational Technology*, 38(2), 260-271.
- Kreijns, K., Kirschner, P., and Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Journal of Education Technology & Society*, 5(1), 8-22.
- Kreijns, K., Kirschner, P., Jochems, W., and van Buuren, H. (2007). Measuring perceived sociability of computer-supported collaborative learning environments. *Computers & Education*, 49(2), 176-192.
- Leuf, B., and Cunningham, W. (2001). *The Wiki Way: Quick collaboration on the web*. Addison Wesley Boston.
- Liu, Y. (2002). What Does Research Say about the Nature of Computer-mediated Communication: Task-Oriented, Social-Emotion-Oriented, or Both? *Electronic Journal of Sociology*. Retrieved June 23, 2009, from <http://www.sociology.org/content/vol006.001/liu.html>
- Lund, A., & Smødal, O. (2006). Is There a Space for the Teacher in a WIKI? In *Proceedings of the WikiSym* (pp. 37-46). ACM Press.
- McAfee, A. (2006). Enterprise 2.0: The Dawn of Emergent Collaboration. *MIT Sloan Management Review*, 47(3), 21-28.
- McGrath, J. (1991). Time, interaction, and performance (TIP): A theory of groups. *Small Group Research*, 22(2), 147-174.
- Mindel, J., and Verma, S. (2006). Wikis For Teaching And Learning. *Communications of the Association for Information Systems*, 18(2006), 1-23.
- Minocha, S., and Thomas, P. (2007). Collaborative Learning in a Wiki Environment: Experiences from a software engineering course. *New Review of Hypermedia and Multimedia*, 13(2), 187-209.
- Parker, K. R., and Chao, J. T. (2007). Wiki as a Teaching Tool. *Interdisciplinary Journal of Knowledge and Learning Objects*, 3, 358-72.
- Ravid, G., Kalman, Y. M., and Rafaeli, S. (2008). Wikibooks in higher education: Empowerment through online distributed collaboration. *Computers in Human Behavior*, 24 (2008), 1913-1928.
- Rovai, A. (2002). Development of an instrument to measure classroom community. *Internet and Higher Education*, 5(3), 197-211.
- Shih, P. C., Muñoz, D., and Sánchez, F. (2006). The effect of previous experience with information and communication technologies on performance in a Web-based learning program. *Computers in Human Behavior*, 22(6), 962-970.
- Vygotsky, L. (1978). *Mind in Society*. Cambridge, MA., Harvard University Press.
- Wagner, C. (2004). Wiki: For Conversational Knowledge Management And Group Collaboration. *Communications of the Association for Information Systems*, 13(2004), 265-289.
- Whitworth, B., Gallupe, B., and McQueen, R. (2000). A Cognitive Three-Process Model of Computer-Mediated Group Interaction. *Group Decision and Negotiation*, 9(5), 431-456.
- Yan, Z. (2006). Different experiences, different effects: a longitudinal study of learning a computer program in a network environment. *Computers in Human Behavior*, 22(3), 364-380.